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EXAMINER	
UMEZ ERONINI, LYNETTE T	
ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 12/18/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/927,863	BAMNOLKER ET AL.	
	Examiner	Art Unit	
	Lynette T. Umez-Eronini	1765	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 September 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6,8-23 and 31-38* is/are pending in the application.

4a) Of the above claim(s) *7 and 24-30* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6,8-23 and 31-38* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1, 3, 4, 5, 6, 9, 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US 5,994,229) in view of Huang (US 6,225,187 B1).

Chen teaches, "Referring now to FIG. **2**, the process starts at **21** with . . . silicon body, or substrate, **2** on which is formed layer of pad oxide . . . A layer of silicon nitride **4** . . . is then laid down (see 22)," (column 3, lines 54-58). "Continuing reference to FIG. **2**, the first of several subprocesses is now used to etch away silicon nitride (see

24):" (column 2, line 65-67). "Once the first subprocess has been terminated, the second subprocess (see **26**), which involves overetching the silicon nitride and etching through the pad oxide . . ." (column 3, lines 21-23). "The . . . first subprocess further comprises: . . . methane trifluoride (CH_3F, a fluorinated hydrocarbon) . . ., carbon tetrafluoride . . ., argon (inert gas) . . . , and oxygen . . . (claim 2). "The . . . second subprocess further comprises: . . . methane trifluoride, . . . a fluorinated hydrocarbon, . . . and argon . . . (claim 3). The aforementioned reads on,

A method of forming a semiconductor structure comprising:

etching through a nitride layer;

etching through an oxide layer; and

etching a semiconductor substrate; wherein:

a last portion of the nitride layer is etched with a nitride etching chemistry comprising a fluorinated hydrocarbon, oxygen, and an inert gas selected from the group consisting of neon, argon, krypton, xenon, and combinations thereof;

a last portion of the oxide layer is etched with an oxide etching chemistry that is different from the nitride etching chemistry; and

the nitride layer is on the oxide layer, and the oxide layer is on the semiconductor substrate, **in claim 1**.

Chen differs in failing to teach the oxide etching chemistry comprises CF_4 and CHF_3, **in claim 1**.

Huang teaches, ". . . (e) etching the exposed hard mask and the underlying oxide layer . . ." (column 1, lines 64 - column 2, line 4). "The oxide layer consists of a silicon

dioxide layer. The hard mask can be nitride selected from the group consists of silicon nitride or silicon oxynitride. The etching process applied in step (e) is dry-etching, wherein the etchant is composed of a mixture of $CHF_3/CF_4/O_2/Ar$ . . ." (column 2, lines 6-12). The aforementioned reads on, the oxide etching chemistry comprises CF_4 along with CHF_3.

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen by using Huang's method of etching an oxide layer comprising CF_4 and CHF_3 for the purpose etching a trench in two steps (Huang, column 2, lines 34-36) as compared to three steps as in the present invention.

The above aforementioned also reads on,

wherein the fluorinated hydrocarbon is selected from the group consisting of CF_4, CH_3F, and combinations thereof, **as in the present claim 4**;

wherein the oxide etching chemistry comprises a fluorinated hydrocarbon is selected from the group consisting of CHF_3, **as in the present claim 5**.

wherein the semiconductor substrate comprises silicon, and wherein the etching of the semiconductor substrate is achieved with a silicon etching chemistry comprising a reagent selected from the group consisting of a halogen gas, a hydrogen halide, oxygen and combinations thereof, **as in the present claim 6;**

the silicon etching chemistry comprises Cl_2, HBr, and O_2, **as in the present claim 9**;

wherein the nitride etching chemistry comprises CF_4, CHF_3, Ar, and O_2, **as in the present claim 10**.

Since Chen uses the same etchant in etching and over etching the nitride layer as that of the claimed invention, then using Chen's etchant and etching method in the same manner as the claimed invention would result in overetching the nitride layer using the nitride etching chemistry by up to and including ten percent of the nitride end point, **as in the present claim 3**.

4. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US '229) in view of Huang (US '187 B1), as applied to claim 1 above, and further in view of Kim et al. (US 6,214,637 B1).

Chen in view of Huang differs in failing to teach an antireflective coating is on the nitride layer and wherein the method further comprises etching the antireflective coating using the nitride etching chemistry.

Kim teaches, layers that are stacked on a semiconductor wafer and that are comprised of a silicon substrate **100** and an ARC layer **106** that overlies a highly reflective layer **104**, (column 4, lines 28-41 and **FIG. 4**). "When the highly reflective layer **104** is a SiN layer, it is possible to simultaneously remove the ARC **106** and the highly reflective layer **104** by . . . oxygen, . . . argon, . . . and . . . CHF_3 . . . (column 5, line 66 - column 6, line 6). The aforementioned reads on, an antireflective coating is on the nitride layer and wherein the method further comprises etching the antireflective coating using the nitride etching chemistry.

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen in view of Huang by using an antireflective coating that is on a nitride layer and etching the antireflective coating using the nitride etching chemistry as taught by Kim for the purpose of providing a method for forming a photoresist pattern, in which the anti-reflective coating (ARC) has excellent etching selectivity, is economical to produce, and is easily removed once the photoresist pattern has been form (column 2, lines 48-52).

5. Claims 8, 11, 12, 13, 14, 15, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen ('229) in view of Huang (US '187 B1) as applied to claim 1 above, and further in view of Bhardwaj et al (US 6,051,503).

Chen in view of Huang differs in failing to specify the flow rate ratio of CF_4 to CHF_3 as recited in claims 8, 11 and 15; the ratio of pressure:top power:bias of the nitride etching chemistry as recited in claims 13 and 14; ratio, the nitride etching chemistry is introduced with a bias of at least -50 V, in claim 12; and the silicon cleaning chemistry is introduced with a bias of at least -50 V, in claim 18.

Bhardwaj teaches. "one or more of the following parameters: gas flow rates, chamber pressure, plasma power, substrate bias, etch rate, deposition rate, cycle time and etching/deposition ratio vary with time" (Abstract), which provides evidence that variations in the gas flow rate, pressure, and plasma power and bias are so-called "result effective variable"

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen in view of Huang by using Bhardwaj as evidence that variations in the gas flow rate, pressure, plasma power and bias are so-called "result effective variables" since it has been held that discovering an optimum value of a result effect variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 206 USPQ 215 (CCPA 1980).

6. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen ('229) in view of Huang (US '187 B1) as applied to claim 1 above, and further in view of Kosugi et al. (US 5,723,383).

Chen in view of Huang differs in failing to teach cleaning the semiconductor substrate with a silicon cleaning chemistry comprising a fluorinated hydrocarbon and an inert gas selected from the group consisting of neon, argon, krypton, xenon, and combinations thereof, as in claim 16 and cleaning the semiconductor substrate using a silicon cleaning chemistry comprising CF_4 and argon, as in claim 17.

Kosugi teaches, "It is also possible to obtain cleaned substrate surfaces by dry etching using plasma formed by various reaction gases such as Ar, H_2, CF_4, . . ." (column 10, lines 45-48).

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen in view of Huang by using Kosugi's method and gases to clean a semiconductor substrate for the purpose of removing unwanted etch residues from the semiconductor substrate.

7. Claims 19-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US '229) in view of Huang (US '187 B1).

Chen teaches, "Referring now to FIG. **2**, the process starts at **21** with . . . silicon body, or substrate, **2** on which is formed layer of pad oxide . . . A layer of silicon nitride **4** . . . is then laid down (see 22)," (column 3, lines 54-58). "Continuing reference to FIG. **2**, the first of several subprocesses is now used to etch away silicon nitride (see **24**):" (column 2, line 65-67). "Once the first subprocess has been terminated, the second subprocess (see **26**), which involves overetching the silicon nitride and etching through the pad oxide . . ." (column 3, lines 21-23). "The . . . first subprocess further comprises: . . . methane trifluoride (a fluorinated hydrocarbon) . . . , carbon tetrafluoride . . . , argon (inert gas) . . . , and oxygen . . . (claim 2). "The . . . second subprocess further comprises: . . . methane trifluoride, . . . a fluorinated hydrocarbon, . . . and argon . . . (claim 3). The aforementioned reads on,

A method of forming a semiconductor structure comprising:

etching through a nitride layer;

etching through an oxide layer; and

etching a semiconductor substrate; wherein:

a last portion of the nitride layer is etched with a nitride etching chemistry comprising CF_4, CHF_3, Ar, and O_2;

the semiconductor substrate is etched with a silicon etching chemistry Cl_2, HBr, and O_2 (claim 14, column 6, lines 29-39 and step 28 of FIG. **2**), **in claim 19**.

Chen differs in failing to teach a last portion of the oxide layer is etched with an oxide etching chemistry that is different from the nitride etching chemistry and the oxide etching chemistry comprises CF_4 and CHF_3;

Huang teaches, ". . . (e) etching the exposed hard mask and the underlying oxide layer . . ." (column 1, lines 64 - column 2, line 4). "The oxide layer consists of a silicon dioxide layer. The hard mask can be nitride selected from the group consists of silicon nitride or silicon oxynitride. The etching process applied in step (e) is dry-etching, wherein the etchant is composed of a mixture of $CHF_3/CF_4/O_2$/Ar . . ." (column 2, lines 6-12). The aforementioned reads on, the oxide etching chemistry comprises CF_4 along with CHF_3.

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen by using Huang's method of etching an oxide layer comprising CF_4 and CHF_3 for the purpose etching a trench in two steps (Huang, column 2, lines 34-36) as compared to three steps as in the present invention.

Since Chen's method of forming a semiconductor structure is the same as that of forming shallow trenches, which are widely used in integrated circuit technology as a means for electrically isolating different parts of the circuit from each other, then using Chen's method of forming a semiconductor structure in the same manner as in the claimed invention would result in making a semiconductor structure, and forming a semiconductor device from the structure, **as in the present claims 20 and 22**; and

forming an electronic device, which comprises the semiconductor device **as in claims 21 and 23**.

Claim Rejections - 35 USC § 102

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

9. Claims 31, 33, 34, 35, 37, and 38 are rejected under 35 U.S.C. 102(b) as being anticipated over Chen et al. (US 5,994,229).

Chen teaches, "Referring now to FIG. **2**, the process starts at **21** with . . . silicon body, or substrate, **2** on which is formed layer of pad oxide . . . A layer of silicon nitride **4** . . . is then laid down (see 22)," (column 3, lines 54-58). "Continuing reference to FIG. **2**, the first of several subprocesses is now used to etch away silicon nitride (see **24**):" (column 2, line 65-67). "Once the first subprocess has been terminated, the second subprocess (see **26**), which involves overetching the silicon nitride and etching through the pad oxide . . ." (column 3, lines 21-23). "The . . . first subprocess further comprises: . . . methane trifluoride (a fluorinated hydrocarbon) . . ., carbon tetrafluoride . . ., argon (inert gas) . . . , and oxygen . . . (claim 2). "The . . . second subprocess further comprises: . . . methane trifluoride, . . . a fluorinated hydrocarbon, . . . and argon . . . (claim 3). The above reads on,

A method of forming a semiconductor structure comprising:

etching through a nitride layer;

etching through an oxide layer; and

etching a semiconductor substrate; wherein:

a last portion of the nitride layer is etched with a nitride etching chemistry comprising a fluorinated hydrocarbon, oxygen, and an inert gas selected from the group consisting of neon, argon, krypton, xenon, and combinations thereof;

a last portion of the oxide layer is etched with an oxide etching chemistry that is different from the nitride etching chemistry; and

the nitride layer is on the oxide layer, and the oxide layer is on the semiconductor substrate, **in claim 31**. Since Chen uses the same etchant in etching and over etching the same (nitride) layer as that of the claimed invention, then using Chen's etchant and etching method in the same manner as the claimed invention would inherently result in overetching the nitride layer using the nitride etching chemistry by up to and including ten percent of the nitride end point, **as in claim 31**.

The said above also reads on,

wherein the fluorinated hydrocarbon is selected from the group consisting of CF_4, CH_3F, and combinations thereof, **as in the present claim 33**;

wherein the oxide etching chemistry comprises a fluorinated hydrocarbon is selected from the group consisting of CHF_3, **as in the present claim 34**.

the semiconductor substrate comprises silicon, and wherein the etching of the semiconductor substrate is achieved with a silicon etching chemistry comprising a

reagent selected from the group consisting of a halogen gas, a hydrogen halide, oxygen and combinations thereof, **as in the present claim 35**; and

the silicon etching chemistry comprises Cl_2, HBr, and O_2 (claim 14, column 6, lines 29-39 and step 28 of FIG. **2**), **in claim 38**.

Claim Rejections - 35 USC § 103

10. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US '229), as applied to claim 31 above, and further in view of Kim (US '637 B1).

Chen differs in failing to teach an antireflective coating is on the nitride layer and wherein the method further comprises etching the antireflective coating using the nitride etching chemistry.

Kim teaches, layers that are stacked on a semiconductor wafer and that are comprised of a silicon substrate **100** and an ARC layer **106** that overlies a highly reflective layer **104**, (column 4, lines 28-41 and **FIG. 4**). "When the highly reflective layer **104** is a SiN layer, it is possible to simultaneously remove the ARC **106** and the highly reflective layer **104** by . . . oxygen, . . . argon, . . . and . . . CHF_3 . . . (column 5, line 66 - column 6, line 6). The aforementioned reads on, an antireflective coating is on the nitride layer and wherein the method further comprises etching the antireflective coating using the nitride etching chemistry.

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen by using an antireflective coating that is on a nitride layer and etching the antireflective coating

using the nitride etching chemistry as taught by Kim for the purpose of providing a method for forming a photoresist pattern, in which the anti-reflective coating (ARC) has excellent etching selectivity, is economical to produce, and is easily removed once the photoresist pattern has been form (column 2, lines 48-52).

11. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US '229), as applied to claim 31 above, and further in view of Huang (US '187 B1).

Chen differs in failing to teach the oxide etching chemistry comprises CF_4 and CHF_3, **in claim 36**.

Huang teaches, " . . . (e) etching the exposed hard mask and the underlying oxide layer . . ." (column 1, lines 64 - column 2, line 4). "The oxide layer consists of a silicon dioxide layer. The hard mask can be nitride selected from the group consists of silicon nitride or silicon oxynitride. The etching process applied in step (e) is dry-etching, wherein the etchant is composed of a mixture of $CHF_3/CF_4/O_2$/Ar . . ." (column 2, lines 6-12). The aforementioned reads on, the oxide etching chemistry comprises CF_4 along with CHF_3.

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen by using Huang's method of etching an oxide layer comprising CF_4 and CHF_3 for the purpose etching a trench in two steps (Huang, column 2, lines 34-36) as compared to three steps as in the present invention.

12. Claim 37 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen ('229) as applied to claim 31 above, and further in view of Bhardwaj et al (US 6,051,503).

Chen differs in failing to specify the flow rate ratio of CF_4 to CHF_3 ranges from on to one and including one to six.

Bhardwaj teaches. "one or more of the following parameters: gas flow rates, . . . vary with time" (Abstract), which provides evidence that variations in the gas flow rate (ratio) is a so-called "result effective variable"

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen in view of Huang by using Bhardwaj as evidence that variations in the gas flow rate (ratio) is a so-called "result effective variables" since it has been held that discovering an optimum value of a result effect variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 206 USPQ 215 (CCPA 1980).

Response to Arguments

13. Applicant's arguments with respect to claims 1-6 and 8-23 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

14. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 703-305-2667. The fax phone number for the organization where this application or proceeding is assigned is 571-272-1435.

ltue

December 8, 2004

SUPERVISOR
NADINE G. NORTON
PRIMARY EXAMINER